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use every possible inquiry, and so exhaust every avenue of approach, and reach the final result as a fact.

Dr. Bleile, in answer to a question from Dr. Taylor, said that the vagi do not seem to serve as brakes on the action of the sympathetic nerves on the heart. Their action or influence will cease after a term, and after the first shock is over, the heart will go on beating for a time after they are cut.

“THE TERMINATION OF THE NERVES IN THE LIVER,” by M. L. Holbrook (Page 95.)

Dr. W. C. Barrétt said, That he believed nerve-tissue to be a simple differentiation of that fundamental substance of which all the rest of the body is made. The ultimate termination of several of the nerves is as yet unknown, and we cannot hope to fully find out this great secret until we first settle more clearly what is the real nature of nerve-force. When we settle it that the nerve-force is nothing more or less than the resultant of the molecular changes which are constantly going on in the nerve, as in the other tissues, we will then be in a condition to realize what we must look for in searching for the nerve termini. Reference has been already made to the action of the heart after its severance from the other tissues, its rhythmic systole and diastole still going on. This is easy to understand, if we bear in mind this view of nerve-force. Just so long as molecular changes can take place in the heart, and in the nerve-lines by which it is ordinarily connected with the rest of the body, just so long will nerve action and muscular activity, resulting therefrom, take place. Just as in the electric battery, so long as the acids and plates are in contact, and their chemism for each other not saturated, will there be currents generated. So in the whole body, so long as molecular changes can go on in the ordinary vital functions, so long may we have nervous and muscular activity. Some animals can transform some of this common bodily force into very manifest electric force, as the *Gymnotus*, or electric eel. Now, whenever we can work out the real connection between nerve-force and the other physical forces, electric-force especially, we shall be in a much better condition to enter upon the inquiry proposed in this most interesting paper. Much

has been done in tracing the nerves out into their filaments, but to trace beyond these filaments those very fine ramifications which in some way must exist, as the nerves must reach the ultimate elements of tissue,—this is a work of vast difficulty, and I rejoice that there are members of this Society so ably at work upon it.

Dr. T. S. Up de Graff said, That Dr. Holbrook has pursued this subject for the past three or four years, and in the most painstaking manner. He pursued it in the laboratory of Dr. Heitzmann, in New York, and I look for still further results from his earnest studies.

Prof. Simon H. Gage said, He observed that Dr. Holbrook had adopted, apparently, the theory of the reticular structure of the blood-corpuscle. Many of the members were much interested in this matter; some who had adopted this view, and others who had not, were alike anxious to discuss and learn about this matter, and learn every method by which the truth can be ascertained. He would like to hear from Dr. Holbrook and others.

Dr. A. M. Bleile said, The question just referred to was a doubly important one, first because we wish to know the fact of these nerve terminations, and second, because the solution of this question may enable us to learn the secret of the nerve force itself. He would like to ask a question: Has Dr. Holbrook used Ranvier's method at all?

Dr. Holbrook said, He had not.

Dr. S. O. Gleason desired to confirm Dr. Holbrook's observations. He had worked with the Doctor in Dr. Heitzmann's laboratory in New York, and he had studied the slides which Dr. Holbrook had sent him from time to time, and he wished to add his own observations in confirmation of the view of the terminations of the nerve fibre which had been set forth.

Dr. Geo. E. Fell said, He hoped there would be a full discussion of the question of the structure of the blood corpuscle which Dr. Holbrook had referred to in his paper. Some of the former pupils of Dr. Heitzmann were present, and others who had claimed to have seen the net-work. The subject was of great interest to the histologist and all interested in the use of the microscope, he hoped the views of those present would be clearly brought out.

President Blackham said the way was open to any one who had a lance to break on the subject.

Dr. Krackowizer said, That he spoke as one whose lance was sure to be broken. He only wished that some one competent to do so would give us a continuation of Prof. A. Y. Moore's article in *The Microscope* for August, with blackboard illustrations. We were all anxious to learn if this reticular structure, or the granular structure, or some other structure, is the true one. To add his mite of information on the subject, he would say that his old instructor in Leipsic, Prof. Ludwig, taught them from *a priori* reasons that it was possible and probable that the red corpuscle had a nucleus, but he never asserted that the nucleus had been seen and its existence demonstrated.

Dr. W. C. Barrett said, That it was with diffidence he attempted to speak upon this subject, because his observations had been limited in extent, and had been made in conjunction with two more competent microscopists who had not seen what to him seemed visible. But if his conclusions were not identical with those of either of his co-laborers, those observers were in no better accord with each other. After all, their united experience only served to corroborate what we had this morning been told, that we are not sure that we see what we think we see, or even that we see anything at all. The supposed appearance in any given case, according to the reasoning of some of our modern Thomases, may be but a diffraction image, and not a reality. Our predilections and prepossessions often lead us astray in graver matters than the observation of these little blood corpuscles. Consciously or unconsciously the biased mind is looking for an expected revelation; and what wonder that in the use of any high microscopical powers the same appearance may be by different observers variously translated.

From *a priori* reasoning, the speaker said, he was predisposed to accept the reticulated structure of protoplasm. It was absurd to suppose that the substance which composes the whole structure of certain complete animals, was structureless. The mind could not conceive of voluntary or spontaneous motion in any structureless body. A drop of homogeneous jelly can only move or change its form by an exertion of external force. Or, if that so-called struct-

ure be but an aggregation of disconnected granules, movement is equally impossible. They must either be connected in some way with each other, or they must have differentiated organs to act as propellers. If then, the *amœba* or the pus-corpuscle be entirely homogeneous, any inherent movement is impossible. Hence we must suppose some kind of structure, and to account for the phenomena exhibited a reticulum of some kind seems most plausible.

Again, it is scarcely probable that we have reached the initial point in biology, which a structureless protoplasm must of necessity form. It will not answer the demands of morphological growth, and hence we must look yet further back for the starting point of organic genesis. Therefore, a structureless sarcode, or one containing but independent granules, seems an utter absurdity.

He did not assert that he had seen the reticulum of Carl Heitzmann, but he does claim that he has observed something more than free granules. If he has not seen these bodies connected by filaments, he has, he thinks, seen movements that can only be explained by some communicating relations that directly point to a filamentous conjunction. The subject is an overwhelmingly important one, and it would better become us, as scientists, to enter into an exhaustive study of the matter, than to content ourselves with endeavoring to tear down that which another has reared upon ground confessedly unexplored by us, save only by casual excursions into its borders. That protoplasm has a structure of some kind was to him a certainty, and the only way in which Heitzmann's theories or observations can be positively disproved is by demonstrating what that structure is. It cannot be accomplished by attacking the competency of a man of ability who has spent his life in microscopical research, or the character of the objectives with which all that we now know of histology has been learned.

Dr. T. F. Lucy said, He was interested in this paper and the discussion. The *Infusoria* and that order of the animal kingdom are sometimes spoken of as nerveless. They are not. They have no nerve-fibers that have ever been discovered, but they have nerve action, and in this he was supported by the Microscopic Society, of which he was a member, and by no less an authority than Prof. Huxley. Doubtless in plants, also, in the same way, nerve

matter and nerve functions exist without any proper fibers. This is of interest in the question of ultimate nerve termination. Wherever there is nerve action there must be, he thought, nervous tissue, whether it was in that highly-organized form known as fibers, or tubes, or what not.

Dr. Krackowizer asked, If any one present would give a plain account from his own experience how slides should be prepared to show the nucleus, or the reticular structure of the human red corpuscle.

Dr. Geo. E. Fell said, That he had failed to see the reticulated structure, though strictly following the directions of Dr. Heitzmann, and using objectives of high-angle, the best that could be procured, made by Ed. Bausch. He had also used high-power lenses, of medium angle. To enumerate: The new formula objective, $\frac{1}{8}$ inch, homogeneous immersion, N. A. 1.43 of Bausch & Lomb; a Spencer "duplex," $\frac{1}{8}$ inch, B. A. 127° , and a $\frac{1}{8}$ inch immersion of Gundlach, of medium angle, were all used in the examinations. Now, if Dr. Heitzmann and his pupils can see this structure, we should likewise see it, for the members of this Society have as good lenses and as good eyes as any body of men in existence. It might appear that the subject was overdone, but when we consider its value to science, if true, and the errors promulgated through acceptance of it, if not so, we cannot make too much of it, or examine into it too closely. He had seen some such structure when the object was out of perfect focus, but it always disappeared when the focus was carefully adjusted. It was not entirely for the histologist to decide the question, but it was open to any good observer with the microscope. The question is not, whether protoplasm has a complicated structure or not; but if it has, is it a reticulated structure, as described by Dr. Heitzmann?

Dr. T. S. Up de Graff said, His experience had been similar. Using a homogeneous $\frac{1}{2}$ inch, by Gundlach, he could see no such structure, except when the lens was in wrong adjustment, or out of focus, when something of the sort was visible.

Dr. J. O. Stillson said, That he had been a student with Dr. Heitzmann, and had very frequently seen the doctor in great enthu-

siasm over the demonstration of this structure. He had often shown it to his students, and of course they assented to it, but he must confess that he had never been able, though using the best modern lenses, to demonstrate the existence of this structure to himself in his own private work since, although he was not ready to actually deny its existence.

Dr. Mercer said, He had put a Powell & Lealand $\frac{1}{12}$ on the corpuscles without finding any such structure. Moreover if such a structure should appear it would be so fine that it would come under Abbe's diffractive laws, and might be really reticular, or something very different, which mathematical analysis only could determine.

Mr. Geo. C. Taylor said, He had hunted for months for this structure, but in vain. He doubted its existence, but was willing to be convinced to the contrary. He described the experience of a friend who had shown some corpuscles to the veteran Dr. Leidy, declaring that *there* was the net-work, and eagerly asking the doctor : "Don't you see it?" received the reply : "Yes, I see it. I see it's granules; but there's no net-work there."

Dr. W. C. Barrett said, He had seen several criticisms of the cuts shown by Heitzmann; but it ought to be remembered that these did not pretend to be actual fac-similes of what could be seen; they are only schematic. It would not do to put away these observations too easily on the plea that the structure is the result of bad focusing. It must be remembered that Dr. Heitzmann and the others are not novices. They know when a glass is in focus.

Mr. E. S. Nott said, He had studied the corpuscle, and had seen the reticular structure when the corpuscle was slightly out of focus.

Dr. M. L. Holbrook said, He had been one of Dr. Heitzmann's pupils formerly. He thought he could state that he had seen the reticular structure often. One would not, however, see the structure in red corpuscles in general. The first case where he saw it was in a corpuscle in some urine, from a case of neuralgic nephritis. He thought, perhaps, from his experience in such observations, that urine was a good re-agent to bring out this structure. Osmic acid was also a good re-agent to bring it out. He did not recollect the

exact proportions to secure the best results. In a work on the brain by Dr. I. Luys, published by Appleton, the structure of the brain cell is given almost precisely the same as Heitzmann gives that of the blood corpuscle. I first saw it in the yeast cell. It shows also in the pus cell; not so readily in pus from a strong constitutioned person as in that of a weak constitutioned one. In ordinary pus the trouble is that you can see only a bright dot, so highly refractive that it shines like silver, and you cannot see any structure, but sometimes you will see a pus corpuscle from which the protoplasm is partially gone, and in them you will be able to see the net-work, and when you see these different kinds of pus corpuscles in the same field it is a pretty sure sign that you have not been deceived by your expectation of seeing the reticular structure. It seems, indeed, most rational to suppose that the cell is organized structure, like all the rest of the body, and not a mere shapeless lump. He further stated that a one-half per cent. solution of osmic acid brings out the structure referred to in the epithelia of the lungs.

Dr. T. S. Up de Graff wished to know if Dr. Holbrook saw this structure only in the shriveled part of the corpuscle, or in all of it.

Dr. Holbrook said, That sometimes, and indeed generally, the other half is entirely empty; there will be nothing at all then to see.

Dr. Mercer wished to know what became of the reticular structure during the great distortions of the amoeboid movement and intramural migrations of the blood corpuscle.

Dr. Holbrook said, He could easily manage that.

Dr. Theodore Deecke said, He had sometimes seen a peculiar reticulated appearance of the blood corpuscle, and had always ascribed it to some peculiar and merely temporary condition of the protoplasm in the corpuscle, and not to any real structure of the corpuscle itself. The blood corpuscle is a very changeable thing, varying in size at different times and in different parts of the body, smaller when it enters the lungs than in other parts of the body, and changing in color and appearance. Hence he had little confidence in the measurement of size being of any evidential value in murder cases. He thought this so-called reticulated structure was

only a peculiar arrangement of the protoplasmic contents of the corpuscle.

President Blackham said, The propriety of discussing here the question of a true or imperfect focus of the objective in the examination of the corpuscle had been called in question, but it should be remembered that the example had been set by Dr. Heitzmann himself, and he had from last year's proceedings of this Society a letter from Dr. H., as given on page 43. When any one assumes to tutor an experienced microscopist in that style, he must not expect his own methods and results to be untouched by criticism. He had himself followed Dr. H.'s directions, as given in the letter just read, explicitly, taking every precaution and using the very best lenses and instruments. He had been shown the structure, too, by Dr. H. himself, in his own laboratory in New York, when he was his guest, and while he was not quite willing, under these circumstances to say to the Doctor that his glass was out of focus, that had been his private judgment at the time. He determined to study it more carefully at home, and did so. He saw the corpuscle full of granules, but with no connection between them. Then, determining to see the structure anyhow, he turned the fine adjustment till clear out of focus, when he saw a sort of blur, extending apparently from one granule to another, which might be regarded as a net-work, but whenever the focus was exactly adjusted this apparent net-work disappeared, and the individual granules reappeared. To make sure of there being no mistake he sent for a friend, a physician and microscopist, on another evening, and without telling what he was in search of, asked him to describe what he saw. He saw and described the granules only. Asking him in a tone of surprise if he did not see the connecting net-work, he said, "No; it might be there, but it must be very obscure; *he* could not see it."

Dr. Krackowizer said, We could not find a verdict for the net-work; half of the witnesses had seen it, and half, or more than half, had not; therefore, according to legal rules of evidence, he did not believe it was there. Certainly, to demonstrate so important a discovery to so large a body of scientific microscopists as are here assembled, was well worth the time of Dr. Heitzmann to come such a short distance as from New York here. He has not even appeared

here at all, and being so exceedingly confident in his own views as we know him to be, it is, to say the least, somewhat significant that he did not even attempt to demonstrate his theory. For himself, he did not regard it as settled that the red blood-corpuscle is even a true cell, with a nucleus and a true membrane or cell-wall. We have as yet no proof that it is a true cell at all.

Dr. A. M. Bleile said, He believed the red corpuscle had a reticular structure of some sort, though he had not seen it himself, and did not believe it was just as Dr. Heitzmann had described it. Some things, going to support his view, he would mention: first, the experiments of Wooldridge with the effect of sulphuric acid: The blood was drawn, defibrinated, and then mixed with a dilute ($\frac{4}{100}$ of one per cent.) solution of sulphuric acid. The corpuscles changed from their ordinary red color to a pale, transparent appearance, showing that the structure of the corpuscle was changed; yet it was not destroyed. He also described Prof. Gaul's experiments with defibrinated frog's blood on the warm stage, when little, worm-like projections shot out from the corpuscle and separated, while its main structure was still remaining, not breaking down till several of these pseudopod-bodies had separated. All this showed that the corpuscle had a structure of some kind, and of some considerable strength,

Dr. J. O. Stillson said, That in experimenting upon bacteria with various reagents he was led to study the effect of strychnia, and so came to notice its action upon the red and the white blood corpuscle, and he had observed an appearance almost identical with that described by Dr. Holbrook. Evidently this motion of the white corpuscle is due to some power residing in itself. Now if there is any such reticular structure a contraction of its fibers might cause those amoeboid movements, and so furnish a satisfactory answer to the question asked awhile ago, as to whether these movements did not disprove the existence of such a structure. If we could prove the structure it would serve to explain the reasons by which such movements were effected. He had applied to the blood various reagents, as hydrocyanic acid, strychnia sulphate, sulphuric acid, extract of calabar bean, etc., etc., and noticed their effects. He observed that the white corpuscle in its amoeboid movements moved

very cautiously over the field of view, but the instant the solution of sulphate of strychnia approached it, it was thrown into terrible convulsions, and soon became apparently dead and still, having then, to his eyes, all the appearance of a pus globule, and having a kind of reticular structure. He distinguished the leucocyte from an ordinary pus globule by the appearance, but chiefly by the action of the above reagents upon it; he did not pretend to tell the difference exactly between a white corpuscle and a pus globule, but could tell by the reagents. He had never seen any sort of reticular structure in the red corpuscle. The color sometimes referred to in the *Deckpfarbe* was produced in the red corpuscle by the above reagents. [?]

AN IMPROVED LAMP FOR USE WITH THE MICROSCOPE (Page 14).

Mr. George C. Taylor exhibited an improved form of microscope lamp. He first described and showed the Hitchcock lamp in its ordinary form. His improvement consists: First—In a separation of the upper and lower parts of the lamp so that the flame was made lower. In the ordinary Hitchcock lamp the flame is too high. The clock-work is placed on one side instead of in the base. Second—In a change in the means of adjustment of the flame. The machinery can vary its speed but slightly, and he found this insufficient. Also the raising or lowering the wick was not satisfactory. He had, therefore, arranged the lamp so that all openings for admission of air were closed, except one, and over that he placed a kind of diaphragm, which can be opened or closed at will. With this the intensity of the light can be regulated with ease and absolute exactness without regard to the wick, and without change in the rate of the clock-work.

President Blackham said, He could testify to the value of the Hitchcock lamp, and was sure this form would be still more useful to the microscopist. The Hitchcock Lamp Co. had also made improvements in their clock-work of late.

"MICRO - PHOTOGRAPHY WITH DRY - PLATE," ETC., by W. H. Walmsley (Page 179).

Prof. A. McCalla asked if Mr. Walmsley had ever used either of the processes for developing a lantern-positive direct from the